Abstract for an Invited Paper
for the DPP10 Meeting of
The American Physical Society

The Physics of Advanced High-Gain Targets for Inertial Fusion Energy[1]

L. JOHN PERKINS, Lawrence Livermore National Laboratory

In ca. 2011-2012, the National Ignition Facility is poised to demonstrate fusion ignition and gain in the laboratory for the first time. This key milestone in the development of inertial confinement fusion (ICF) can be expected to engender interest in the development of inertial fusion energy (IFE) and expanded efforts on a number of advanced targets that may achieve high fusion energy gain at lower driver energies. In this tutorial talk, we will discuss the physics underlying ICF ignition and thermonuclear burn, examine the requirements for high gain, and outline candidate R&D programs that will be required to assess the performance of these target concepts under various driver systems including lasers, heavy-ions and pulsed power. Such target concepts include those operating by fast ignition, shock ignition, impact ignition, dual-density, magnetically-insulated, one- and two-sided drive, etc., some of which may have potential to burn advanced, non-DT fusion fuels. We will then delineate the role of such targets in their application to the production of high average fusion power. Here, systems studies of IFE economics suggest that we should strive for target fusion gains of around 100 at drive energies of 1MJ, together with corresponding rep-rates of up to 10Hz and driver electrical efficiencies around 15%. In future years, there may be exciting opportunities to study such "innovative confinement concepts" with prospects of fielding them on facilities such as NIF to obtain high fusion energy gains on a single shot basis.

[1]This work performed under the auspices of the U.S. DOE by LLNL under Contract DE-AC52-07NA27344 and supported by LDRD-08-ERD-050.